Such systems constrain the user to handling the brush in a manner that can be extremely difficult, and that often results in accidental contact with brush nodules and brush surfaces intended to clean substrate surfaces. Moreover, a more robust packaging system that can survive drop tests used in the industry would be desirable.

SUMMARY

Embodiments of the ~~claimed~~ invention make up for the shortcomings of known CMP brush packaging systems by not only providing mechanical and chemical protection during shipping and storage, but also by providing methods for users to grasp the CMP brush while still partially protected by packaging elements, such that it can safely be placed onto a process tool without contamination.

Embodiments of the invention include packaging for a CMP brush on a core that is at least partially covered by a loose polymeric sleeve or flexible sheet that has one or more slits, or one or more perforations, in the sheet that allow the sheet to be removed from the brush while it is mounted on the tool by a user. The polymeric sleeve or sheet allows the brush on the core to be mounted on the tool without the need for gloves and minimizes or eliminates adding contaminants to the brush surface (for example if scissors were used to open the sleeve). The flexible sheet may cover as much of the CMP brush as necessary for a worker to handle the brush.

The CMP brush that is partially covered by the flexible sheet can be further contained in a liquid-tight sealed outer wrap, such as a polymeric container, which in some embodiments comprises a polymeric bag. In an embodiment, the outer wrap may include a tear notch at one end that allows opening of the outer wrap without the need for scissors or other contamination-introducing tools. The outer wrap is liquid tight and can contain water and/or other preservatives like hydrogen peroxide or ammonium hydroxide.

In an embodiment, the outer wrap, which in an embodiment comprises a polymeric container, has an opening and internal dimensions that allow it to accommodate a sleeve covered CMP brush on a core wherein the core can have one or more removable end-support structures mounted to the ends of the brush. These end-supports may comprise disks, rings or other geometric structures that when mounted to the brush core, keep the brush and brush nodules offset from a surface, such as a surface of a tubular shipping container. Offsetting the brush from a surface protects the nodules from deformation during shipping and handling. In some embodiments the flexible sheet can cover the support structures, though in other embodiments, the flexible sheet only covers a cylindrical portion of the brush.

An outer housing, such as a tubular shipping container, can be placed around the CMP brush, with optional support structures on its ends, that is partially covered by the polymeric sleeve or flexible sheet with one or more slits. The outer housing provides protection to the brush during shipping. The outer housing or tubular shipping contain may have a geometric cross section that allows the CMP brush with end supports mounted to the brush to be placed within the housing or tubular shipping container; the end supports can keep brush surfaces and nodules from touching an inside surface of the outer housing/tubular shipping container. The outer housing can have one or more caps that retain the CMP brush in the housing.

In some embodiments, the outer housing may have end caps that also function as the support structures. The brush can be fit into or adjacent these support structures during packaging. This advantageously can reduce the amount of packing material.

~~The claimed invention includes a number of embodiments, including~~ According to a first aspect of the present invention, there is provided a method of packaging a CMP brush having a cylindrical brush portion and a pair of end connection portions, the method comprising: at least dampening the brush with a liquid; covering the cylindrical brush portion with a flexible sheet that extends around and engages the surface of the cylindrical portion; engaging each of the end connection portions with a respective end support, the end supports having a flange portion with a diameter greater than a maximum diameter of the cylindrical portion; inserting the dampened brush into a rigid polymer tubular shipping container having a tubular wall with an inside surface, whereby the end supports keep the cylindrical brush portion from contact and from deformation of the cylindrical portion by the tubular wall; and providing an additional exterior self-supporting packaging around the rigid polymer shipping container.

~~In an embodiment, the claimed invention may also comprise~~ According to a second aspect of the present invention, there is provided a packaged CMP brush, the brush comprising a cylindrical brush portion with a cylindrical surface and a pair of end connection portions, the packaging comprising: a flexible polymer sheet material extending around the cylindrical portion and circumferentially engaging and covering the cylindrical portion; a pair of end support portions supportingly engaging each of the end connection portions, each end support portion having a central engagement feature in engagement with the end connection portion and a flange portion extending radially beyond the radial extent of the cylinder; a rigid polymer shipping container, the end support portions engaging the ends of the polymer shipping container whereby the brush is

suspended therein with the cylindrical surface spaced from the rigid polymer shipping container; and the rigid polymer shipping container hermetically sealed.

~~In an embodiment, the claimed invention also includes~~ According to a third aspect of the present invention, there is provided a method of unpacking and installing a CMP brush, from a CMP package, the CMP package comprising the CMP brush having a dampened cylindrical foam portion and two opposite end portions, the packaging comprising a polymer sheet material wrapping and engaging the cylindrical portion, a pair of end support portions engaging the opposite end portions of the CMP and engaged with a self-supporting shipping container; the method comprising: removing the CMP brush with supports from the self-supporting polymer shipping container, removing the end supports from the cylindrical brush while retaining the polymer sheet material wrapping the cylindrical brush portion, manually grasping the cylindrical brush by way of the polymer sheet material wrapping the cylindrical brush portion such the surface of the brush portion is not contacted by the users hand; affixing the brush to the brush fixture whilst holding the cylindrical brush by way of the polymer sheet material, and removing the polymer sheet material.

~~In an embodiment, the claimed invention comprises~~ According to a fourth aspect of the present invention, there is provided a method of packaging a CMP brush having a cylindrical brush portion with radially extending nodules and a pair of end connection portions, the method comprising: covering the cylindrical brush portion with a flexible sheet that extends around and engages the nodules without deforming the nodules; engaging each of the end connection portions with a respective end support, the end supports having a flange portion with a diameter greater than a maximum diameter of the cylindrical portion; inserting the brush into a rigid polymer tubular shipping container having a tubular wall with an inside surface, whereby the end supports keep the nodules from contact and from deformation of the cylindrical portion by the tubular wall; and providing an additional exterior self-supporting packaging around the rigid polymer shipping container.

~~In an embodiment, the claimed invention also comprises~~ According to a fifth aspect of the present invention, there is provided a method of shipping a CMP brush having a cylindrical brush portion with nodules and a pair of end connection portions, the method comprising: providing three polymer coverings to the cylindrical brush portion: one being a non-self-supporting wrap wrapped around the cylindrical portion and engaging the nodules, wherein the non-self-supporting wrap is selected from the group consisting of a flexible material and a semi rigid material; another one being a sealed bag;

and the final one being a tubular shipping container sized with an inside diameter larger than a maximum diameter of the brush portion; enclosing the cylindrical brush portion within the three polymer coverings.

~~In an embodiment, the claimed invention also comprises~~ According to a sixth aspect of the present invention, there is provided a method of protecting a CMP brush having a cylindrical brush portion with radially extending nodules and a pair of end connection portions, the method comprising: having the brush dampened; wrapping the cylindrical brush portion and nodules with a non-self supporting wrap whereby the cylindrical brush may be grasped by a user's hand without the hand directly contacting the brush, wherein the non-self-supporting wrap is selected from the group consisting of a flexible material and a semi rigid material.

~~In an embodiment, the claimed invention comprises~~ According to a seventh aspect of the present invention, there is provided a packaged CMP brush, the brush having a cylindrical brush portion with nodules and a pair of end connection portions, the packaging comprising: three polymer coverings to the cylindrical brush portion, the three polymer coverings comprising: a non-self supporting wrap wrapped around the cylindrical portion and engaging the nodules without deforming the nodules, wherein the non-self-supporting wrap is selected from the group consisting of a flexible material and a semi rigid material; a sealed bag; and a rigid tubular shipping container sized with an inside diameter larger than a maximum diameter of the brush portion; wherein the CMP brush is sealingly enclosed in the rigid tubular shipping container and spaced from a tubular wall of the container.

These, and other, aspects of the invention will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. The following description, while indicating various embodiments of the invention and numerous specific details thereof, is given by way of illustration and not of limitation. Many substitutions, modifications, additions or rearrangements may be made within the scope of the invention, and the invention includes all such substitutions, modifications, additions or rearrangements.

BRIEF DESCRIPTION OF DRAWINGS

The drawings accompanying and forming part of this specification are included to depict certain aspects of the invention. A clearer impression of the invention, and of the components and operation of systems provided with the invention, will become more readily apparent by referring to the exemplary, and therefore non-limiting, embodiments

CLAIMS

~~What is claimed is:~~

1. A method of packaging a CMP brush having a cylindrical brush portion and a pair of end connection portions, the method comprising:

at least dampening the brush with a liquid;

covering the cylindrical brush portion with a flexible sheet that extends around and engages the surface of the cylindrical portion;

engaging each of the end connection portions with a respective end support, the end supports having a flange portion with a diameter greater than a maximum diameter of the cylindrical portion;

inserting the dampened brush into a rigid polymer tubular shipping container having a tubular wall with an inside surface, whereby the end supports keep the cylindrical brush portion from contact and from deformation of the cylindrical portion by the tubular wall; and

providing an additional exterior self-supporting packaging around the rigid polymer shipping container.

2. The method of claim 1, further comprising applying an additional polymer sheet wrap covering to the exterior of the polymer tube with the end connection portions supported therein.

3. The method of claim 2 further comprising selecting the additional sheet wrap material to have shrink wrap capabilities and heating the additional sheet wrap to shrink it thereby hermetically sealing the brush therein.

4. The method of claim 1 further comprising selecting a sleeve as the flexible sheet to extend around the cylindrical portion and covering the cylindrical portion comprising insertion of the brush into the sleeve.

5. The method of claim 4 further comprising selecting the sleeve to have one of a tear conducive region or a slit.

6. The method of any of the above claims further comprising selecting a cardboard box with a square shape on the end view as the additional exterior self-supporting packaging.

7. The method of any of the above claims further comprising selecting end support portions having a flange portion being disk shaped and having central engagement structure for engagement with the axial center of the brush.

8. The method of any of claims 1-6 further comprising providing an addition sealed polymer bag as packaging.

9. The method of any of claim 1-6 further comprising inserting the support portions inside the polymer tubular shipping container and installing a rigid cap on each open end of the tubular shipping container.

10. The method of claim 9 further comprising hermetically sealing the rigid cap.

11. A packaged CMP brush, the brush comprising a cylindrical brush portion with a cylindrical surface and a pair of end connection portions, the packaging comprising:

a flexible polymer sheet material extending around the cylindrical portion and circumferentially engaging and covering the cylindrical portion;

a pair of end support portions supportingly engaging each of the end connection portions, each end support portion having a central engagement feature in engagement with the end connection portion and a flange portion extending radially beyond the radial extent of the cylinder;

a rigid polymer shipping container, the end support portions engaging the ends of the polymer shipping container whereby the brush is suspended therein with the cylindrical surface spaced from the rigid polymer shipping container; and

the rigid polymer shipping container hermetically sealed.

12. The packaged CMP brush of claim 11, wherein the hermetic seal is provided by an additional polymer sealed bag.

13. The packaged CMP brush of claim 11 wherein the hermetic seal is provided by polymer shrink wrap covering the rigid polymer shipping container.

14. The packaged CMP brush of claim 11 wherein the rigid polymer shipping container is configured as rigid tube and wherein the end supports are engaged with ends of the tube.

15. The packaged CMP brush of any of claims 11-14, further comprising a cardboard box with a square end shape, the brush enclosed therein.

~~14~~16. The packaged CMP brush of any of claims ~~11-14~~ 11-15, wherein the flexible polymer sheet material extending around the cylindrical portion is configured as a sleeve.

~~15~~17. The packaged CMP brush of claim ~~14~~, 16 wherein the sleeve has structure facilitating opening, the structure comprising at least one of a slit, perforations, and a tear-conducive region.

~~16~~18. The packaged CMP brush of any of claims ~~11-14~~ 11-17, wherein the flexible polymer sheet material extending around the cylindrical portion is a rectangular sheet rolled up on the cylindrical portion.

~~17~~19. A method of unpacking and installing a CMP brush, from a CMP package, the CMP package comprising the CMP brush having a dampened cylindrical foam portion and two opposite end portions, the packaging comprising a polymer sheet material wrapping and engaging the cylindrical portion, a pair of end support portions engaging the opposite end portions of the CMP and engaged with a self-supporting shipping container; the method comprising:

removing the CMP brush with supports from the self-supporting polymer shipping container, removing the end supports from the cylindrical brush while retaining the polymer sheet material wrapping the cylindrical brush portion,

manually grasping the cylindrical brush by way of the polymer sheet material wrapping the cylindrical brush portion such the surface of the brush portion is not contacted by the users hand;

affixing the brush to the brush fixture whilst holding the cylindrical brush by way of the polymer sheet material, and

removing the polymer sheet material.

~~18~~20. The method of claim ~~17~~19, wherein the polymer sheet is configured as a sleeve and removing the polymer sheet is accomplished by tearing a tear portion in the polymer sleeve and then removing the sleeve.

~~19~~21. A method of packaging a CMP brush having a cylindrical brush portion with radially extending nodules and a pair of end connection portions, the method comprising:

covering the cylindrical brush portion with a flexible sheet that extends around and engages the nodules without deforming the nodules;

engaging each of the end connection portions with a respective end support, the end supports having a flange portion with a diameter greater than a maximum diameter of the cylindrical portion;

inserting the brush into a rigid polymer tubular shipping container having a tubular wall with an inside surface, whereby the end supports keep the nodules from contact and from deformation of the cylindrical portion by the tubular wall; and

providing an additional exterior self-supporting packaging around the rigid polymer shipping container.

~~20~~22. A method of shipping a CMP brush having a cylindrical brush portion with nodules and a pair of end connection portions, the method comprising:

providing three polymer coverings to the cylindrical brush portion:

one being a non-self-supporting wrap wrapped around the cylindrical portion and engaging the nodules, wherein the non-self-supporting wrap is selected from the group consisting of a flexible material and a semi rigid material;

another one being a sealed bag; and

the final one being a tubular shipping container sized with an inside diameter larger than a maximum diameter of the brush portion;

enclosing the cylindrical brush portion within the three polymer coverings.

~~21~~23. The method of shipping a CMP brush having a cylindrical brush portion with nodules and a pair of end connection portions of claim ~~20~~22, the method further comprising:

spacing the CMP brush from the tubular shipping container inside the container.

~~22~~24. A method of protecting a CMP brush having a cylindrical brush portion with radially extending nodules and a pair of end connection portions, the method comprising:

having the brush dampened;

wrapping the cylindrical brush portion and nodules with a non-self supporting wrap whereby the cylindrical brush may be grasped by a user's hand without the hand directly contacting the brush, wherein the non-self-supporting wrap is selected from the group consisting of a flexible material and a semi rigid material.

~~23~~25. The method of claim ~~22~~24 further comprising placing the brush inside a tubular shipping container with the nodules spaced from a wall of the container.

~~24~~26. The method of claim ~~22~~24 further comprising:

engaging each of the end connection portions with a respective end support, the end supports having a flange portion with a diameter greater than a maximum diameter of the cylindrical portion; and

providing an additional exterior self-supporting packaging around the rigid polymer shipping container.

~~25~~27. A packaged CMP brush, the brush having a cylindrical brush portion with nodules and a pair of end connection portions, the packaging comprising:

three polymer coverings to the cylindrical brush portion, the three polymer coverings comprising:

a non-self supporting wrap wrapped around the cylindrical portion and engaging the nodules without deforming the nodules, wherein the non-self-supporting wrap is selected from the group consisting of a flexible material and a semi rigid material;

a sealed bag; and

a rigid tubular shipping container sized with an inside diameter larger than a maximum diameter of the brush portion;

wherein the CMP brush is sealingly enclosed in the rigid tubular shipping container and spaced from a tubular wall of the container.